section 9

CD V-715-1B

specifications:

- Ranges: 0-0.5, 0-5, 0-50, 0-500 r/hr
- Sensing Element: Ionization Chamber
- Accuracy: ±20% of true dose rate from cobalt 60 or cesium 137 gamma radiation
- Battery: One 1-1/2 volt NEDA 13
- Dimensions: approx. 9" long x 4-1/2" wide x 6" high including handle
- Weight: approx. 3 lbs. including battery

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GENERAL DESCRIPTION

Introduction

The Victoreen CD V-715 model 1B is a portable ionization chamber instrument designed for the detection of high levels of gamma radiation. The ionization chamber is located inside the case in the lower front portion of the instrument. The entire instrument and its accessories include a printed circuit board, indicating meter, ionization chamber, carrying strap, and strap fastener.

Meter and Controls

The CD V-715-1B uses a ruggedized, sealed meter to meet the instrument requirements for water-tightness, shock, and vibration resistance. Two controls are provided. One control is a range selector switch which turns the instrument on, checks its operation, and selects the desired sensing range. The other is a zero control which is used to adjust the instrument to assure proper reading. Zeroing compensates for temperature variations and battery aging.

Adjustments and Readings

Zero Adjust

Turn the instrument on by turning the range switch from OFF to the ZERO position. Wait about a minute to allow the electrometer tube to warm up, then orient the ZERO control until the meter indicates zero. The instrument must be zeroed before attempting to check the circuitry or use any of the sensing ranges.

Circuit Check

Turn the range switch from the ZERO position to the CIRCUIT CHECK position. The range switch must be held against the stop in this position since the switch is spring-loaded to return to OFF. The meter should read in or above the red outlined section labeled CIRCUIT CHECK. Refer to the Trouble Shooting Guide for corrective measures if a low reading is obtained. Weak or dead batteries are often the cause of inability to zero or circuit check the instrument.

The zeroing and circuit check operations may be performed at any time whether the instrument is in a radiation field or not. However, the instrument must be zeroed before making the circuit check.

Sensing Ranges

The radiation sensing ranges are activated by turning the range switch to X100, X10, X1, or X0.1. The sensing ranges can be checked only for erratic or upscale readings unless a radioactive source is available. In the absence of radiation the meter should return to within 3 minor divisions of zero after allowing a few seconds for transient currents to dissipate.

Table 9-1 lists switch positions and the corresponding meter readings. Figure 9-1 shows the meter face. Readings should not be taken with the pointer indicating in the lower 10% of the scale. Turn to the next most sensitive range until the pointer indicates in the upper 90% of the scale.

Switch Position	R/hr
X0.1	0-0.5
X1	0-5
X10	0-50
X100	0-500

Table 9-1. Switch Positions vs Meter Readings

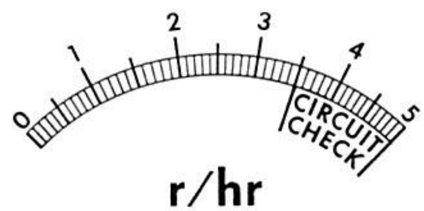


Figure 9-1. Meter Face

Battery

The CD V-715-1B is powered by one 1-1/2 volt "D" size flashlight cell. The battery will operate the instrument continuously for over 150 hours and much longer on an intermittent basis. Many units will operate as long as 300 hours continuously. Refer to Appendix A for acceptable types and makes of batteries.

Installation

Open the instrument by opening the pull catch at each end of the case and separating the top from the case bottom. Insert the battery in the battery compartment observing the indicated polarity. (See figure 9-2) The battery compartment is designed to be mechanically selective so that batteries cannot be inserted with reversed polarity. Close the case by aligning the top with the case bottom and closing the pull catches.

Replacement

The battery should always be checked before making further instrument

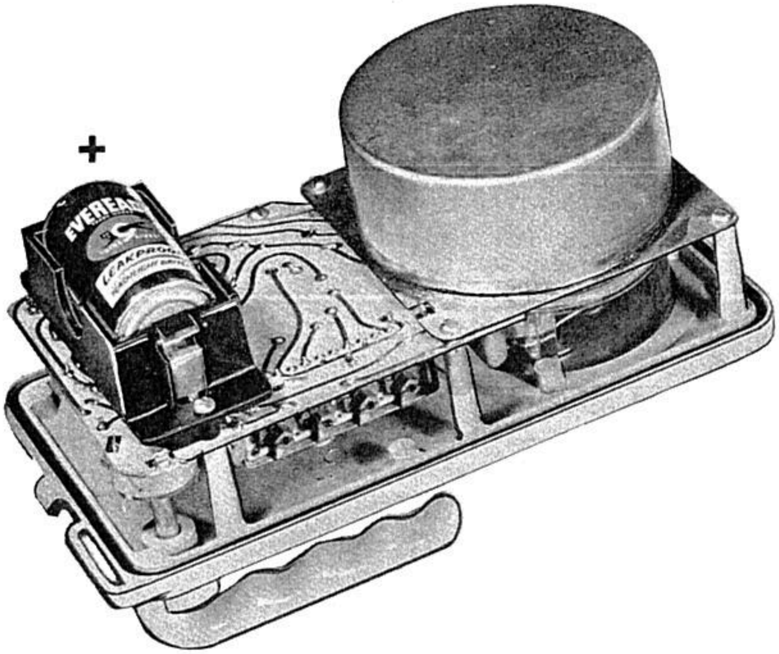


Figure 9-2. Battery Installation

repairs or adjustments. The battery may be checked with a voltmeter while installed in the instrument. With the range switch in the ZERO position, the battery should measure at least 1.25 volts under load. The battery may also be removed and checked with a battery tester.

Good batteries are required since a direct relationship exists between battery voltage and instrument response to radiation. Instruments with very weak batteries may give errors in radiation response even though satisfactory circuit check and zero adjustment may be obtained.

Electronic Circuitry

All electrical components which make up the circuitry are fastened to a printed circuit board. The circuitry serves to measure the minute current from the ionization chamber which indicates the presence of ionizing radiation. The high impedance components are housed in a light-tight enclosure for protection and shielding. Electrometer Tube, Hi-Megs } light sensitive.

Input Circuit

The minute ionization current from the chamber collector at 0.5 R/hr — about 7 micromicroamperes — flows through a 220,000 megohm resistor and develops a voltage drop of about 1.4 volts across the resistor. This voltage is also applied to the grid of the electrometer tube, V1, which is connected as a triode. The range switch changes high megohm resistor values to keep the voltage applied to the electrometer tube grid within the proper operating range.

Measuring Circuit

A 50 microampere meter is used to measure the change in current through the electrometer tube. The static plate current is cancelled by running a reverse current, supplied by the filament battery BT1, through the meter. The magnitude of this current is fixed by the bucking resistor R11. The zero control, R2, changes the bias on the electrometer tube. When R2 is adjusted properly, the meter reads zero. High megohm resistors R12 through R15 are input resistors for the electrometer tube on the various ranges. When the ionization chamber is exposed to radiation, a positive voltage is developed across the high megohm resistor chosen by the range switch. This voltage results in an increase in tube current, and the indicating meter reads upscale in proportion to the radiation intensity.

Resistors R10A, R10B, R10C, and R10D are calibrating potentiometers which shunt some of the current around the meter on the various ranges. In the CIRCUIT CHECK position, resistor R9 serves to change the bias on the electrometer tube, making the meter read upscale.

Power Supply

Three separate d.c. voltages are required: the plate voltage supply of 10.5 volts, the grid bias supply of -3.8 volts, and the ion chamber collecting voltage of 50 volts.

All of these voltages are obtained from a transistor oscillator circuit. Transistor Q1, battery BT1 and the primary of transformer T1 constitute this oscillator. Feed-back to the base of Q1 from the upper portion of T1 through capacitor C1 serves to sustain oscillation. The three output voltages are rectified from the a.c. output of the secondary of T1 by rectifiers CR1, CR2, and CR3.

50 10.5

3.8

Variations in output voltage with battery voltage and load current changes are prevented by the regulating network R5 and R6. This network feeds back a portion of the plate supply voltage to the base of Q1 so as to control the bias current. Thus the battery current and magnitude of oscillation are controlled in such a fashion as to keep the plate voltage constant. This method of regulation limits the battery drain through Q1 when the battery is new and hence contributes to long battery life.

SERVICING

Precautions

High Impedance Circuitry

The high megohm resistors, electrometer tube, ceramic switch wafer, and ionization chamber feed-thru insulator constitute the high impedance circuitry of the CD V-715-1B. Any accumulation of dirt or grease on these parts will render the instrument inoperable. These parts must not be handled except in accordance with instructions in Section 1 of this Manual.

Semi-Conductor Components
(Diodes and Transistors)

The semi-conductor components used in the instrument may be damaged by prolonged heating during soldering. When replacing any of these components, the soldering operation should be done quickly. Hold the lead between the component and the joint with a heat sink to decrease the amount of heat transmitted to the component. Techniques are described in Section 1 of this Manual.

Electrometer Tube

When checking the electrometer tube filament, use an ohmmeter which has an output current of less than 10 ma when used to measure resistances of about 100 ohms. Current in excess of 10 ma may destroy the filament. No damage

will result from use of the ohmmeters described in Appendix B.

Disassembly Instructions

1. Open the pull catches and remove the instrument from the case bottom.
2. Remove the two screws securing the battery box to the instrument top. Swing the battery box away from the circuit board. Wiring between the battery box and the circuit board prevents complete separation of the battery box.
3. Remove the four screws which secure the ionization chamber and its grounding spring.
4. Remove the meter connecting leads at the meter terminals.
5. Remove the knob from the ZERO control. It is not necessary to remove the range switch knob.
6. Remove the other screws holding the circuit board to the case top, and remove the circuit board by pressing on the ZERO control shaft and pulling lightly on the circuit board.
7. Remove the range switch drive shaft from the circuit shield box without changing the position of the switch wafer inside.
8. Remove the two screws holding the circuit shield box to the circuit board, and remove the circuit shield box.

The instrument is now completely disassembled. Reassembly is the reverse of the disassembly procedure. The switch index and the switch wafer must both be oriented in the same position.

Preventive Maintenance

It is recommended that preventive maintenance procedures be carried out once a month when the instrument is in use and once every six months when the instrument is in storage as follows:

1. Remove the battery and clean the battery contacts and battery terminals if necessary to remove any corrosion present.
2. Replace the battery making certain that it makes good contact and exceeds the minimum voltage.
3. Perform the Zero and Circuit Check operations.

Do not use cleaning solvents on the plastic parts. Use soap and water to clean the case. If the battery has leaked, remove the case bottom and fill it with warm water. The battery spillage will be loosened in a short while and can be rinsed out. Dry the case carefully before reassembling. HUMI-SORB desiccant or its equivalent should be packed in the case bottom of the instrument upon receipt at warehouses and upon completion of servicing or periodic maintenance.

Repairs

Electrometer Tube Replacement

Follow the disassembly instructions through step 8. Unsolder the grid lead of the electrometer tube and pull the tube from its socket. Use tweezers or needle-nosed pliers as shown in figure 9-3 to aid in removing the leads.

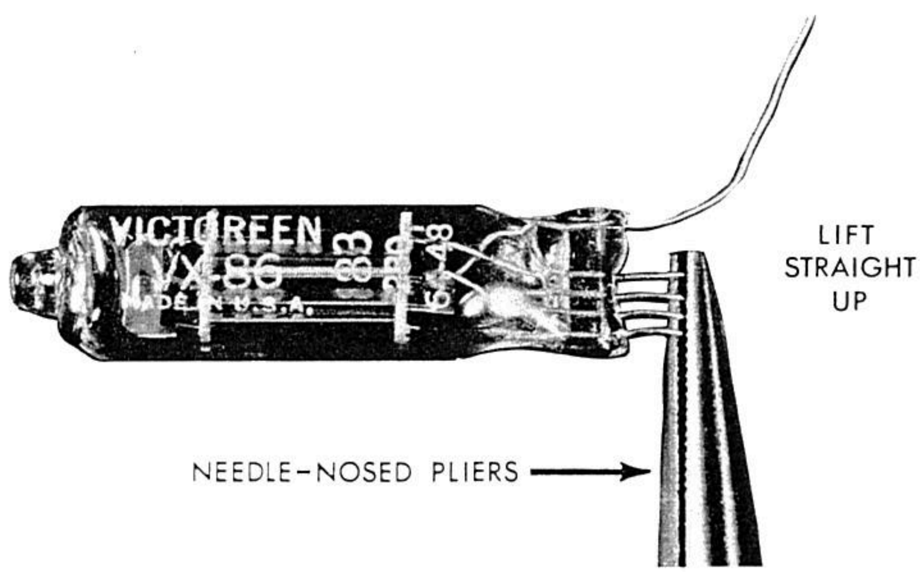


Figure 9-3. Electrometer Tube Removal

Avoid handling the tube near the base since fingerprints will cause electrical leakage paths. The tube should be installed by reversing the above procedure. Note that socket pin 3 is not used. Do not allow the grid lead of the tube to

touch the circuit shield box since this can cause upscale readings or insensitivity.

Chamber Contact Spring Repair

The brass chamber contact spring should be visible approximately 3/8" inside the hole near the front of the circuit board. The purpose of this spring is to make contact with the electrode pin of the ionization chamber when it is installed. If the spring is pushed too far up into the shield box, remove the shield box and bend the spring down toward the circuit board. Do not attempt to bend the spring by inserting a soldering aid through the hole in the circuit board since this often displaces or breaks the electrometer tube.

Switch Replacement

All switch contacts are mounted on one ceramic switch wafer. The switch index and drive shaft are removable separately for ease of disassembly and replacement. To remove the switch wafer, follow the disassembly instructions through step 8, then proceed as follows:

1. Unsolder the leads of R14 and R15 from the switch.
2. Unsolder the electrometer tube grid lead.
3. Unsolder the lead at the end of R13 from the circuit board.
4. There are two recommended methods for lifting the switch terminals from the circuit board. Use method (a) below if the switch wafer is to be saved. Method (b) is faster but should be used only when the wafer is known to be defective beyond repair.
   (a) Heat each switch terminal on the circuit board, one at a time, and pry upward carefully on the switch wafer with a soldering aid. See figure 9-4. Repeat this procedure several times until all terminals are free. Do not use excessive heat or damage to the circuit board plating will result.
   (b) Cut each switch terminal close to the top of the circuit board with diagonal cutters. Heat and remove the remaining portion of each terminal.
5. Remove the high megohm resistors and the chamber contact spring.
6. Place a jumper wire on the new wafer in the same position as on the old one.

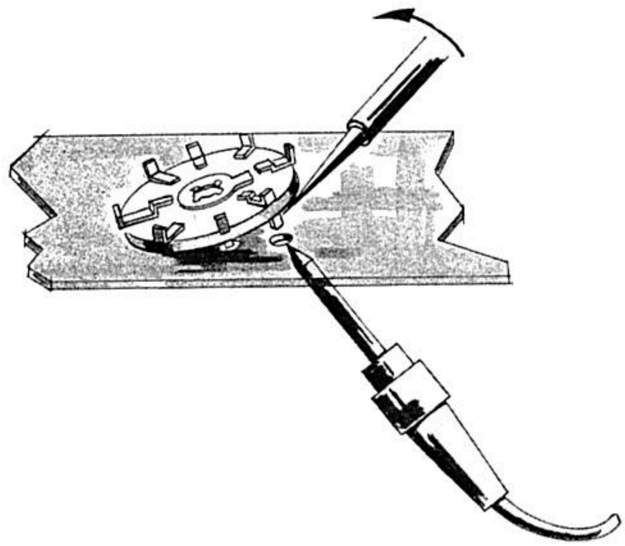


Figure 9-4. Switch Removal

7. Open the holes on the circuit board with a soldering pencil and soldering aid to allow the switch terminals to be inserted.
8. Install the new switch wafer by reversing steps 5, 3, 2, and 1. Solder each switch terminal using a minimum amount of heat.

Zero Potentiometer Replacement

The zero potentiometer, R2, is soldered directly to the printed circuit board. To remove, follow the disassembly instructions through step 6, then use either method (a) or method (b) below. Method (a) should be used if the potentiometer is to be saved. Method (b) is faster but destroys the potentiometer terminals.

(a) Heat the three mounting lugs and the three terminals, one at a time, and press sideways on the potentiometer shaft. This will tend to lift the terminals from the circuit board. Repeat this procedure several times, pushing away from the solder joint each time, until the potentiometer is free.

(b) Cut the three terminals with diagonal cutters. Heat the three mounting lugs, one at a time, and press sideways on the potentiometer shaft. This will tend to lift the lugs from the circuit board.

Repeat this procedure several times, pushing away from the solder joint each time, until the potentiometer is free. Heat and remove the remaining portions of the terminals.

To install the new potentiometer, open the holes on the circuit board with a soldering pencil and soldering aid. Be sure the potentiometer is seated properly so that the shaft will fit through the hole in the case top.

Trouble Shooting

The information in this section is presented as an aid to the service technician in determining the causes of specific instrument faults. The Trouble Shooting Guide lists the most probable causes of instrument failure together with suggestions for corrective action. This should be consulted and followed after the following preliminary steps have been taken:

1. Disassemble the instrument through step 3 of the Disassembly Instructions.
2. Check the battery. Make sure it provides sufficient voltage for proper operation of the instrument.
3. Check the printed circuit board for broken foil, cold solder joints, or solder bridges.
4. Check for broken components.

Table 9-2, Test Point Chart, and figure 9-5, Location of Test Points, eliminate the need for circuit tracing when making voltage and resistance measurements. The Test Points are referred to in the NOTES column of the Trouble Shooting Guide, and are also found on the schematic circuit diagram.

TROUBLE SHOOTING GUIDE

RANGE SWITCH POSITION	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
ZERO	Dead	Poor connection to battery	Repair connection	
		Meter defective	Repair or replace meter	
		Open contact on S1A	Repair switch	Check continuity at Q - ▲
	Downscale	Zero control improperly adjusted	Turn zero control fully counterclockwise, then clockwise until instrument zeroes	
		V1 filament open or making poor contact to socket	Replace V1 or repair connection	Check resistance at Q - E
		CR1 shorted	Replace CR1	Lift one end of CR1, check instrument again
		CR2 defective	Replace CR2	Check voltage at R
		Q1 defective	Replace Q1	Check Q1 for beta and shorts

RANGE SWITCH POSITION	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
ZERO (cont'd)	Downscale (cont'd)	✓T1 defective	Repair or replace T1	Check resistances at E - L, L - K, N - M, M - J esp. E - L, L - K will be less than 1.4 Ω
		C1 open	Replace C1	
		C3 shorted	Replace C3	
		C4 defective	Replace C4	
		C7 shorted	Replace C7	
	Upscale	CR3 defective	Replace CR3	Check voltage at A
		V1 defective	Replace V1	Check V1 for shorts
	WILL NOT COME DOWN SCALE TO ZERO HR, A, HIGH	*T1 defective (open)	Replace T1	CHECK RESISTANCE M-J
	*RESISTANCE MAY CHECK GOOD	C1 shorted	Replace C1	Voltage at H, R high
		C6 shorted	Replace C6	Voltage at A low
		R2 defective	Repair or replace R2	
	Erratic	Meter defective	Repair or replace meter	
	CR1	CR2 defective	Replace CR2	
	UPSCALE & Erratic T1	Open contact on S1A	Repair switch	Check continuity at Q - ▲
		Open contact on S1B	Repair switch	Check continuity at S - A
		R2 defective	Repair or replace R2	
		V1 defective	Replace V1	

CIRCUIT CHECK	Below Red Area	Battery low or making poor contact	Replace battery or repair contact	
		CR1 shorted	Replace CR1	Voltage at H low
		C3 open	Replace C3	
		Open contact on S1C	Repair switch	Check continuity at Q - P
		V1 transconductance low	Replace V1	Check Voltage R - ⏚ 10.5 v
Radiation Sensing Ranges	Upscale on one or more ranges, but greatest effect on X0.1 range [illegible] Q1	Moisture contaminating high impedance components	Dry out with heat (150°F or less) or desiccant [illegible]	
		Chamber defective	Repair or replace chamber	Remove chamber and check instrument again
		V1 defective	Replace V1	Check V1 for grid current
	Pegs upscale on all ranges	V1 defective	Replace V1	Check V1 for shorts
	No response to radiation on all ranges	Chamber spring not making contact to chamber terminal	Bend chamber spring	
		Poor contact at circuit board grounding point	Tighten screw	
		Chamber defective	Replace chamber	
		CR1 defective	Replace CR1	Voltage at H=0 or low
		C2 shorted	Replace C2	

RANGE SWITCH POSITION	SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION	NOTES
Radiation Sensing Ranges (cont'd)	No response to radiation on all ranges (cont'd)	C5 shorted V1 defective	Replace C5 Replace V1	 Check V1 for transconductance
*	Low response to radiation on all ranges	Chamber defective Meter M1 defective CR1 defective V1 defective	Repair or replace chamber CHECK ON TESTER Replace CR1 Replace V1	 Voltage at H low Check V1 for transconductance
Note:	No response to radiation on only one range	Calibration control turned fully counterclockwise High megohm resistor dirty or defective S1B defective	Recalibrate on particular range Clean or replace high megohm resistor Repair switch	 Check resistances at A - S Check resistances at A - S
	Low response to radiation on only one range	Calibration disturbed High megohm resistor dirty or defective	Recalibrate on particular range Clean or replace high megohm resistor	 Check resistance at A - S
	Erratic response to radiation	Poor connection at chamber contact spring Poor connection at circuit board grounding point	Bend spring Tighten screw	

		Dirt on ceramic switch wafer	Clean switch	
		Chamber defective	Replace chamber	
		Meter defective	Repair or replace meter	
		CR1 defective	Replace CR1	
		Q1 beta too high	Replace with transistor having proper gain	
		S1B defective	Repair switch	Check resistances at S - A
		S1C defective	Repair switch	Check continuity at Q - F, Q - D, Q - C, Q - B
		V1 defective	Replace V1	

RESISTANCE CHART

Remove battery before checking resistances. All values ±20%

Component	Points	Range Switch Position	Resistance (ohms)
S1A	Q - ▲	All except OFF	0
S1B and hi-megs	S - A	CIRCUIT CHECK ZERO X100 X10 X1 X0.1	0 0 2.2×10^{8} 2.2×10^{9} 2.2×10^{10} 2.2×10^{11}
*S1C	Q - P Q - F Q - D Q - C Q - B	CIRCUIT CHECK X100 X10 X1 X0.1	0 0 0 0 0
*V1 filament	Q - E	Any	80 - 150
T1	E - L L - K N - M M - J	Any Any Any Any	1.4 1.4 53 675

*Remove one meter terminal before making this test.

VOLTAGE CHART

Voltages measured with respect to point ▲ with instrument correctly zeroed on ZERO range. Use a 20,000 ohms per volt meter. All values ±20%.

Point	Voltage	Voltmeter Range
H	50 45	250
R	10.5 9	50
A	-3.8 3.5	50
G	1.7	2.5
E	1.5	2.5

Table 9-2. Test Point Chart

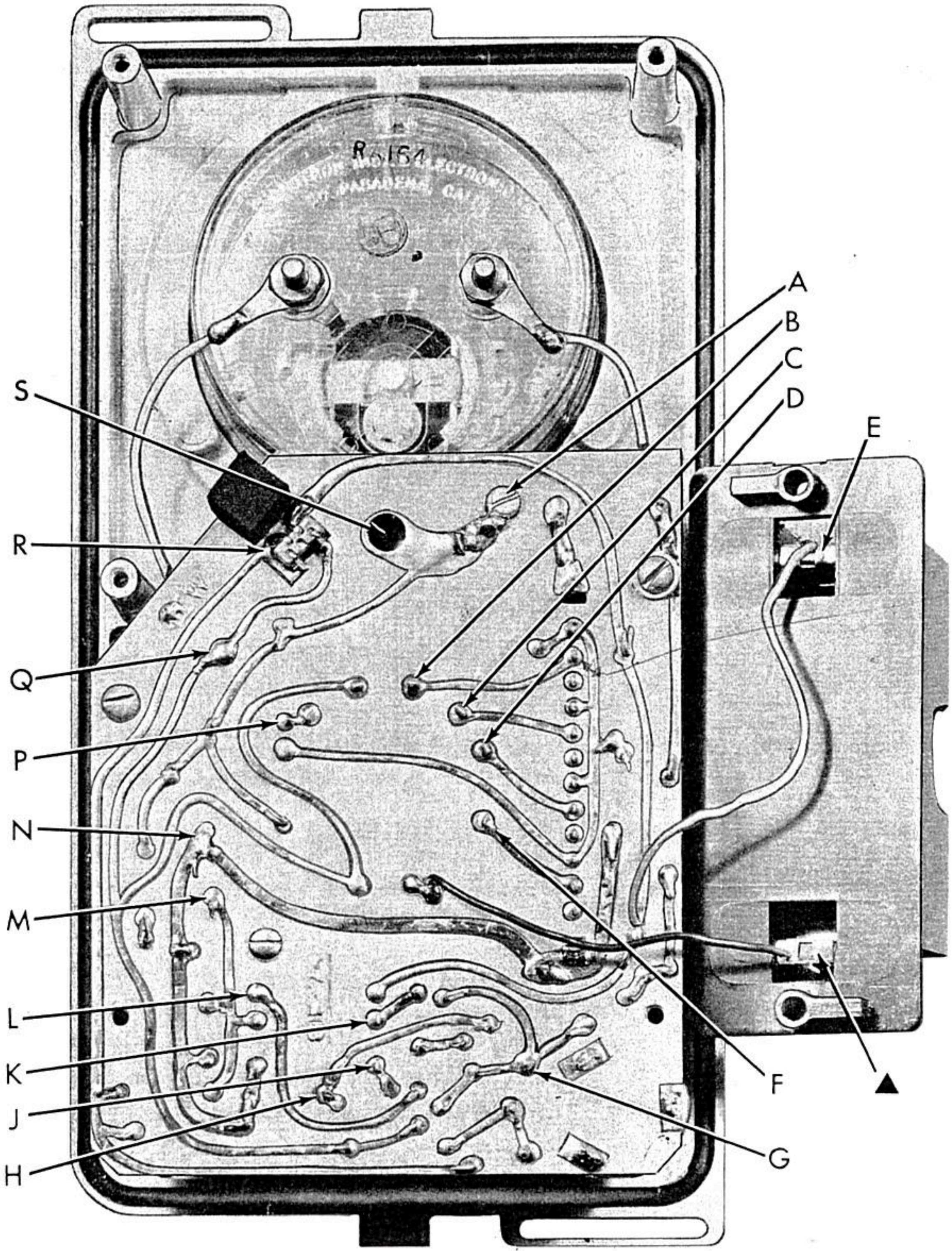
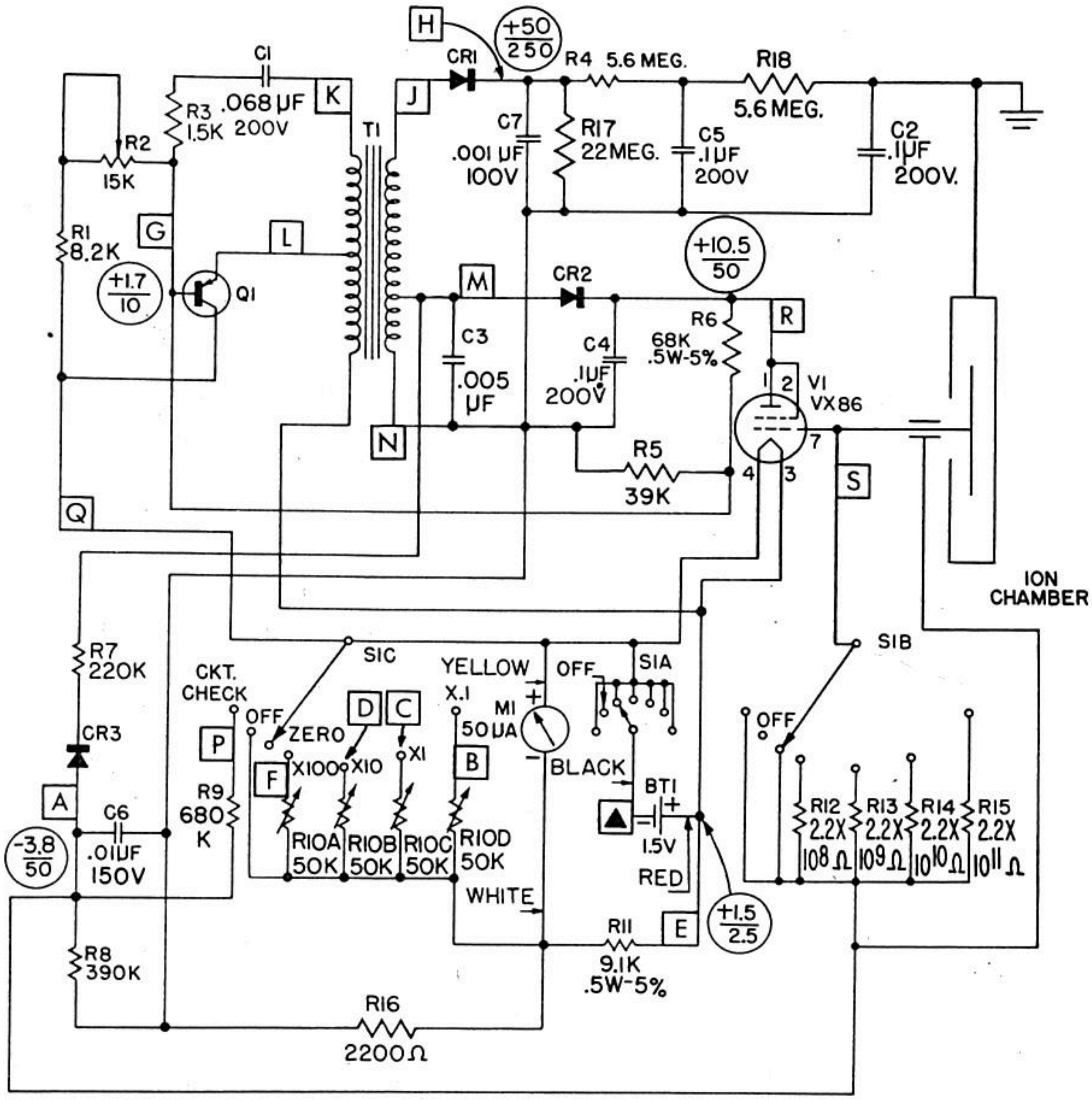


Figure 9-5. Location of Test Points



NOTES:

All resistance values in ohms

All capacitance values in microfarads

[A] indicates Test Points

VOLTAGE RANGE — Voltages measured with respect to point ▲ with instrument correctly zeroed on ZERO range. Use a 20,000 ohms per volt meter

Figure 9-6. Schematic Circuit Diagram

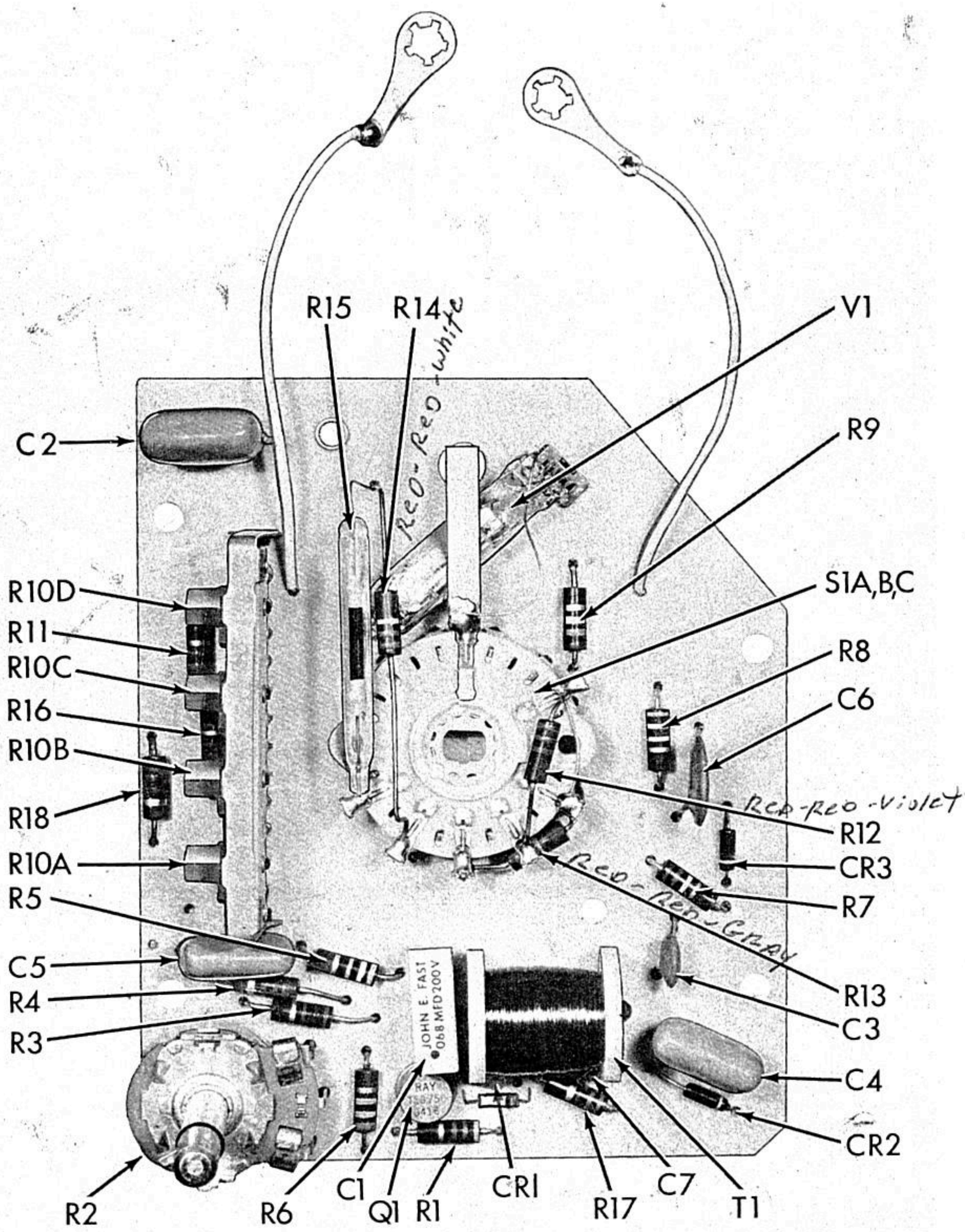


Figure 9-7. Location of Components

PARTS LIST

Electrical Components

Circuit Symbol	Description	Function	Manufacturer & Part No.	Victoreen Part No.
BT1	Battery "D" size 1-1/2V NEDA 13	D.C. power supply to oscillator and VX86 filament	Union Carbide 950	16-4
C1	Capacitor 0.068 ufd 200V	Oscillator base coupling capacitor	John E. Fast Co. F303B683-3	21-408
C2	Capacitor 0.1 ufd 200V	Filter capacitor	John E. Fast Co. F303B104-3	21-407
22044 C3	Capacitor 0.005 ufd 50V 20%	Oscillator tank capacitor	American Capacitor Co.	21-387
C4	Capacitor 0.1 ufd 200V	VX86 plate supply filter capacitor	John E. Fast Co. F303B104-3	21-407
C5	Capacitor 0.1 ufd 200V	Chamber voltage filter capacitor	John E. Fast Co. F303B104-3	21-407
C6	Capacitor 0.01 ufd 150V	Grid bias voltage filter capacitor	Aerovox Corp. 5010017810021420	21-257
C7	Capacitor 0.001 ufd 100V ceramic	Chamber voltage filter capacitor	Aerovox Corp. 5002043710012420	21-404
22201 CR1	Diode, silicon	Chamber voltage supply rectifier	Victoreen Instrument Co. 52-99	52-99

	Circuit Symbol	Description	Function	Manufacturer & Part No.	Victoreen Part No.
22200	CR2	Diode, silicon	Plate voltage supply rectifier	Victoreen Instrument Co. 52-100	52-100
22200	CR3	Diode, silicon	Grid bias voltage rectifier	Victoreen Instrument Co. 52-100	52-100
22129	M1	Meter 50ua	Visual indication	Victoreen Instrument Co. 815-28	815-28
22202	Q1	Transistor PNP germanium	Power supply oscillator	Texas Instrument, Inc. GA-1806	23-34
	R1	Resistor 8.2K 1/2W 10%	Transistor base bias resistor	Stackpole Carbon Co.	185-200
	R2	Potentiometer 15K 1/2W	Zero adjust	Centralab BA893-199	22-160
	R3	Resistor 1.5K 1/2W 10%	Transistor base current limiter	International Resistance Co. GBT-1/2	185-351
	R4	Resistor 5.6 meg 1/2W 10%	Decoupling filter, chamber voltage supply	International Resistance Co. GBT-1/2	185-406
	R5	Resistor 39K 1/2W 10%	Voltage divider, oscillator regulator circuit	Stackpole Carbon Co.	185-244
	R6	Resistor 68K 1/2W 5%	Voltage divider, oscillator regulator circuit	International Resistance Co. GBT-1/2	185-156
	R7	Resistor 220K 1/2W 10%	Series limiter, grid bias supply	Stackpole Carbon Co.	185-331

Circuit Symbol	Description	Function	Manufacturer & Part No.	Victoreen Part No.
R8	Resistor 390K 1/2W 10%	Load resistor, grid bias supply	Stackpole Carbon Co.	185-306
R9	Resistor 680K 1/2W 10%	Circuit check, shifts grid bias	Stackpole Carbon Co.	185-337
R10	Potentiometer	—	Centralab YAN001-27E6F	22-187
R10A	Section of R10 50K	X100 Calibration adjustment	—	—
R10B	Section of R10 50K	X10 Calibration adjustment	—	—
R10C	Section of R10 50K	X1 Calibration adjustment	—	—
R10D	Section of R10 50K	X0.1 Calibration adjustment	—	—
R11	Resistor 9.1K 1/2W 5%	Zero signal bucking current limiter	International Resistance Co. GBT-1/2	185-214
R12	Resistor 2.2×10^{8} ohms 20%	X100 grid resistor	Victoreen Instrument Co. 185-1372	185-1372
R13	Resistor 2.2×10^{9} ohms 20%	X10 grid resistor	Victoreen Instrument Co. 185-1371	185-1371
R14	Resistor 2.2×10^{10} ohms 20%	X1 grid resistor	Victoreen Instrument Co. 185-1370	185-1370
R15	Resistor 2.2×10^{11} ohms 20%	X0.1 grid resistor	Victoreen Instrument Co. 185-1377	185-1377

	Circuit Symbol	Description	Function	Manufacturer & Part No.	Victoreen Part No.
	R16	Resistor 2200 ohms 1/2W 10%	Feedback resistor	Stackpole Carbon Co.	185-657
	R17	Resistor 22 meg 1/2W 10%	High voltage bleeder	Stackpole Carbon Co.	185-275
	R18	Resistor 5.6 meg 1/2W 10%	Decoupling filter, chamber voltage supply	International Resistance Co. GBT-1/2	185-406
	S1	Switch wafer, ceramic	———	Victoreen Instrument Co. 815-84	815-84
	S1A	Section of S1	Battery switch	———	———
21349	SIB	Section of S1	High megohm resistor selector	———	———
	S1C	Section of S1	Calibration resistance selector	———	———
	T1	Transformer	Power supply oscillator	Victoreen Instrument Co. 14-61	14-61
22136	V1	Electrometer tube VX86	Ion current detector	Victoreen Instrument Co. 35-134	35-134
21376	V2	Ionization chamber	Radiation detector	Victoreen Instrument Co. 815-15	815-15

Mechanical Components

Description	Function	Manufacturer & Part No.	Victoreen Part No.
Battery compartment	Holds batteries	Victoreen Instrument Co. 815-4	815-4
Battery contact (2)	Electrical connections to batteries	Victoreen Instrument Co. 700-68	700-68
Case bottom ass'y	Bottom of instrument case	Victoreen Instrument Co. 815-78	815-78
Case gasket	Water seal between case top and bottom	Victoreen Instrument Co. 720-157	720-157
Case top and handle ass'y	Carrying handle and instrument panel	Victoreen Instrument Co. 815-80	815-80
Chamber contact spring	Connects ion chamber to electrometer tube circuit	Victoreen Instrument Co. 815-19	815-19
Instruction manual (2)	Operating instructions	Victoreen Instrument Co. 815-71	815-71
Knob	Range switch knob	Harry Davies Molding Co. 1500K	9-9
Knob	Zero adjust knob	Harry Davies Molding Co. 1450AC	9-14
Meter gasket	Water seal between case top and meter	Victoreen Instrument Co. 815-70	815-70

Description	Function	Manufacturer & Part No.	Victoreen Part No.
"O" ring (2)	Shaft seal	Cleveland Ball Bearing Co. 5427-1	46-38
Printed circuit board, processed	Supports components	Victoreen Instrument Co. 815-81	815-81
Rubber gasket	Between switch drive shaft and shield box	Victoreen Instrument Co. 44-48	44-48
Shield box	Shields high impedance components	Victoreen Instrument Co. 815-22	815-22
Shoulder strap	Carrying strap	Victoreen Instrument Co. 700-81	700-81
Strap buckle (2)	Carrying strap length adjustment	Waterbury Buckle Co. 807 5047	710-44
Strap fastener (2)	Attaches shoulder strap	Victoreen Instrument Co. 815-47	815-47
Switch drive shaft	Connects switch index to switch wafers	Victoreen Instrument Co. 815-33	815-33
Switch index	Positions range switch	Victoreen Instrument Co. 815-36	815-36
Tube socket	Holds electrometer tube	Elco Mfg. Corp. 05-0788-51	33-45